CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: December 12, 2011 FILE REF: 3600

TO: Sue Beyler

FROM: Benjamin Heussner, Steven Gospodarek, Luke Roffler and Andrew Notbohm

SUBJECT: Comprehensive Survey Report of Nagawicka Lake – Waukesha County (WBIC 828000).

ABSTRACT

A comprehensive fisheries survey of Nagawicka Lake was conducted in the spring of 2010 to assess local gamefish and panfish populations. Species targeted included walleye, northern pike, smallmouth bass, largemouth bass, and panfish. Quality gamefish size structure was observed in all gamefish species present, although abundance of some species is low when compared to other Waukesha County lakes.

Walleye catch rates were relatively low while size structure was above average during fyke netting on Nagawicka Lake. Female walleye size structure was larger than that of males with female proportional stock densities roughly equivalent to that of males, but preferred stock densities of females was nearly double that of males. Overall catch of female walleyes outnumbered males 2:1 during the spring survey. Total adult density was estimated at 0.4 fish per acre.

Northern pike fyke netting catch rates were above average for Waukesha County with almost 2 fish captured per net night. Size structure was good with 11.3% of the fish captured above the 26-inch minimum size limit. The largest northern pike observed during fyke netting was 39.2 inches long.

Smallmouth bass electrofishing catch rate was relatively low on Nagawicka; slightly above 10 fish captured per hour. Size structure is good with almost 38% of the captured smallmouth measuring longer than the 14-inch minimum length limit. The largest smallmouth bass observed was 20-inches long.

Largemouth bass were more frequently observed than smallmouth bass during the survey. Largemouth bass electrofishing catch rate was 2.4 times higher than smallmouth bass at 24 fish captured per hour. Smallmouth bass captured during the survey showed large size structure, with over 40% measuring longer than the 14-inch minimum length limit including one that measured 20.8 inches.

Though not a targeted species, common carp do not appear to be having a negative effect on Nagawicka Lake with only 2 carp captured during the entire survey. Observations of healthy native aquatic plant communities and good water quality indicate no significant negative effect from common carp.

White suckers appear to be a vital component to this fishery as many were observed both while fyke netting and electrofishing. The high density of white suckers can be attributed to their ability to migrate unobstructed up the Bark River to spawn. Dam removal is critical if white sucker populations are to be reestablished on other lakes in this system. This species plays an important role in producing quality fish such as the 25.1-inch walleye, 39.2-inch northern, 20-inch smallmouth bass, and 20.8-inch largemouth bass that were captured during the survey.

Bluegill and rock bass were the most frequently observed panfish species in Nagawicka Lake. Almost 5,000 bluegills were captured with the average size being almost 6 inches. Some of the largest bluegills

seen were close to 9 inches. Over 2,500 rock bass were captured during the survey with the average size being 6.5 inches. Other panfish species captured during the survey include yellow perch, black crappie, and pumpkinseed.

Other species of note that were captured include bowfin, yellow bullhead, and lake chubsucker which is a species of special concern in Wisconsin. Catch rate for these species was very low.

METHODS

The 2010 comprehensive fisheries survey of Nagawicka Lake began on March 22nd, with the setting of seven fyke nets. Up to 14 total nets were fished on Nagawicka Lake through April 15th (Figure 1). Of the 14 nets fished, 11 featured four-foot frames while three featured three-foot frames. Each of the 14 nets were made up of ¾-inch bar white nylon mesh All fish species were measured to the nearest tenth-inch and a subsample of gamefish were also weighed to the nearest tenth-pound. Walleye and northern pike were given finclips to identify recaptures and facilitate abundance estimates (female – right pectoral, male – left pectoral, unknown or immature – top caudal), as were largemouth and smallmouth bass (top caudal).

Electrofishing sampling began with a walleye recapture run on April 14th. Electrofishing focusing on bass and panfish began on the evening of April 19th. A total of 11 electrofishing runs were conducted on Nagawicka Lake on 10 different nights through May 18th. The total shocking effort for walleyes was 2.75 hours, 25.75 hours for largemouth and smallmouth bass, and 0.25 "catch all" hours in which all species were collected.

Mark and recapture efforts during fyke netting and electrofishing produced population estimates for walleye, northern pike, largemouth bass, and smallmouth bass. Walleye and largemouth bass abundance was estimated using the Petersen formula $N = \frac{MC}{R}$, where M is the number of marked fish at large, C is the number of fish captured during the recapture run, and R is the number of recaptured fish identified during the recapture run. Sample size was not sufficient enough for a smallmouth bass population estimate. Northern pike population size was estimated using the modified Schnabel formula $N = \frac{\Sigma(C_t M_t)}{R+1}$, where C_t is the number of fish captured on a given day, M_t is the number of marked fish at large on each day, and R is the total number of recaptured fish during the sampling period.

Scales for ageing were collected from largemouth bass, northern pike, smallmouth bass, and walleye, which allowed for estimation of growth and survival rates for each species. Mean length and catch per effort were calculated for all species sampled.

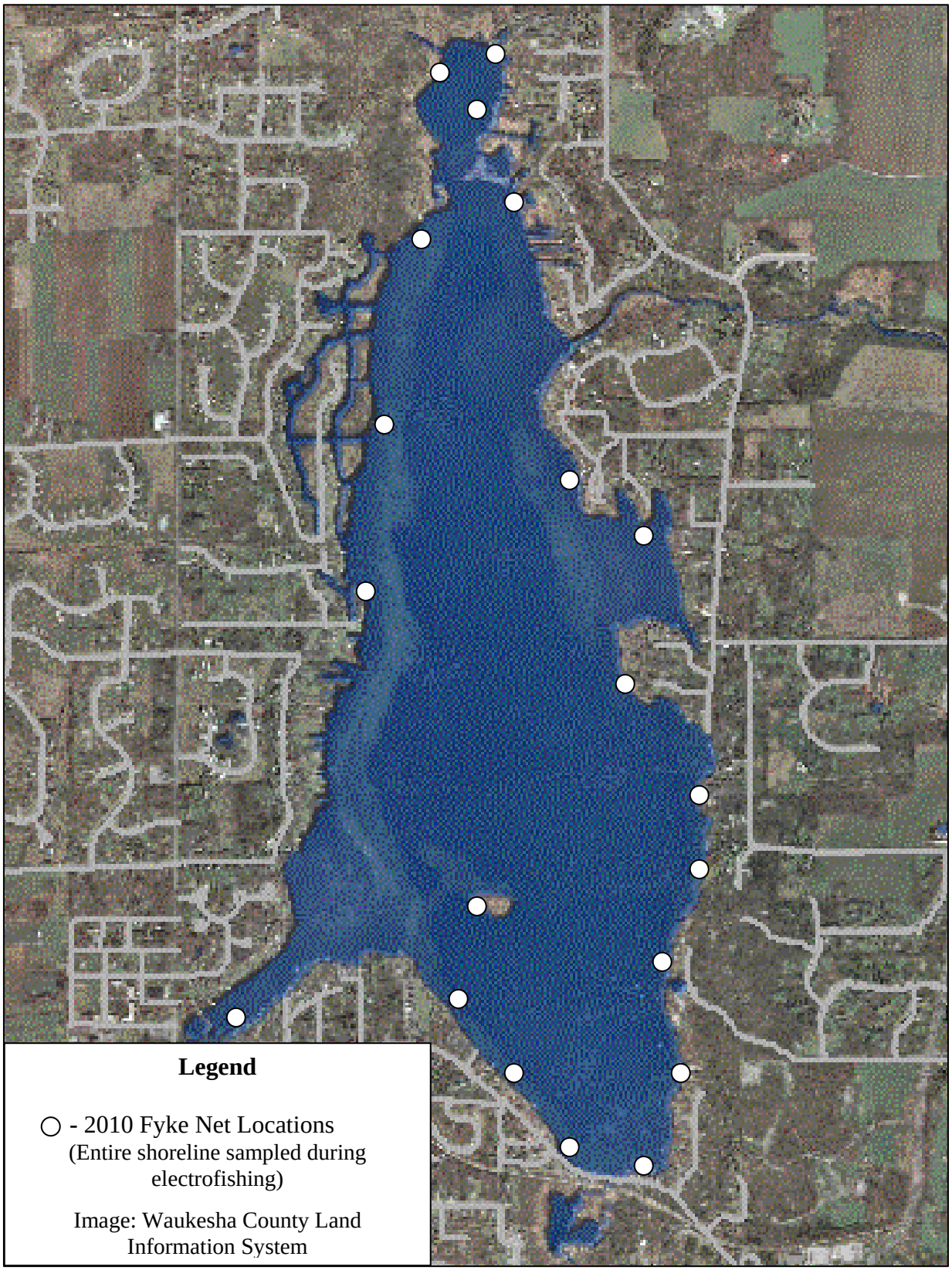

Figure 1. Spring 2010 comprehensive survey map of Nagawicka Lake showing fyke net locations.

RESULTS

Walleye

In March and April of 2010, walleyes in Nagawicka Lake were sampled by fyke net followed by a single recapture electrofishing run. Fyke netting catch rates, mean lengths, and mean weights for female, male, and unknown walleyes were quantified and summarized (Table 1).

Table 1. Walleye captured by fyke net from Nagawicka Lake in spring of 2010. Total effort of 289 net nights.

Sex	Number Caught	Mean Length (in)	St. Dev	Mean Weight (lbs)	St. Dev	CPE
Male	46	18.97	1.08	2.470	0.43	0.159
Female	68	20.29	1.87	3.291	0.98	0.235
Total	114	19.76	1.72	2.929	0.88	0.394

The largest walleye captured during fyke netting was a 25.1-inch female, whereas the largest male was 21.3 inches. Female walleyes showed a length frequency mode of 19.6 inches, while males showed a modal length of 18.3 inches (Figure 2).

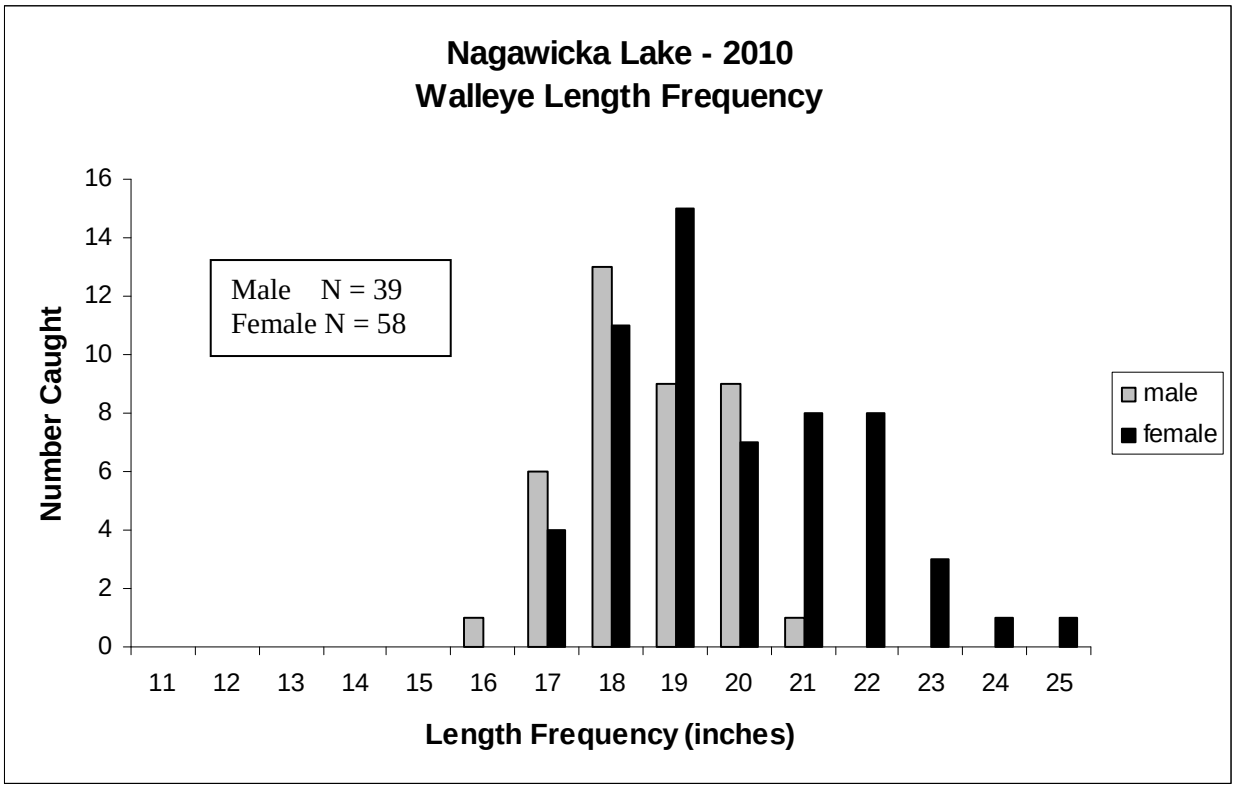

Figure 2. Walleye length frequency for Nagawicka Lake. Fish were captured by fyke netting during the spring 2010 comprehensive survey.

Walleye catch rates during the electrofishing recapture run was low. Twelve walleye were captured at a rate of 4.8 fish per shocking hour. These 12 walleyes showed an average length of 14.9 inches. The largest fish captured during the run was a 19.7 inch male (Table 2).

Table 2. Walleye captured by electrofishing from Nagawicka Lake in spring of 2010. Total effort of 2.5 hours.

Sex	Number	Catch/Hour	Mean Length	Std. Dev.
All	12	4.8	14.89	2.93

Gender-specific proportional stock density (PSD), using a stock length of 10 inches and a quality length of 15 inches, showed good size structure of female and male walleyes. Female PSD was 98.4%, whereas male PSD was 100%. Female relative stock density (RSD-20), using a stock length of 10 inches and a preferred length of 20 inches, was 47.6%, compared to 24.4% for males.

Walleyes from Nagawicka Lake were given differential finclips throughout spring sampling, allowing for a mark and recapture effort to estimate abundance. The resulting population estimate using the Petersen formula indicated 388 adult walleye in Nagawicka Lake (95% confidence intervals of 170 and 1,768), or 0.4/acre (Table 3).

Table 3. Walleye mark and recapture data and Petersen population estimate from Nagawicka Lake in spring of 2010 (R/C=0.25, CV=50.0%).

Marked M	Examined C	Recaptured R	Population Estimate N	Lower 95% C.I.	Upper 95% C.I.
97	12	3	388	170	1,768

Scales for ageing were collected from walleye, allowing for calculation of growth rates and comparison to the Wisconsin statewide average. Walleyes in Nagawicka Lake showed growth rates greater than the state average until age 7. Once walleyes in Nagawicka Lake reached this age, growth rates decreased to match the state average (Figure 3). Nagawicka Lake female walleye growth rates slightly out paced that of male walleyes showing normal growth patterns (Figure 4).

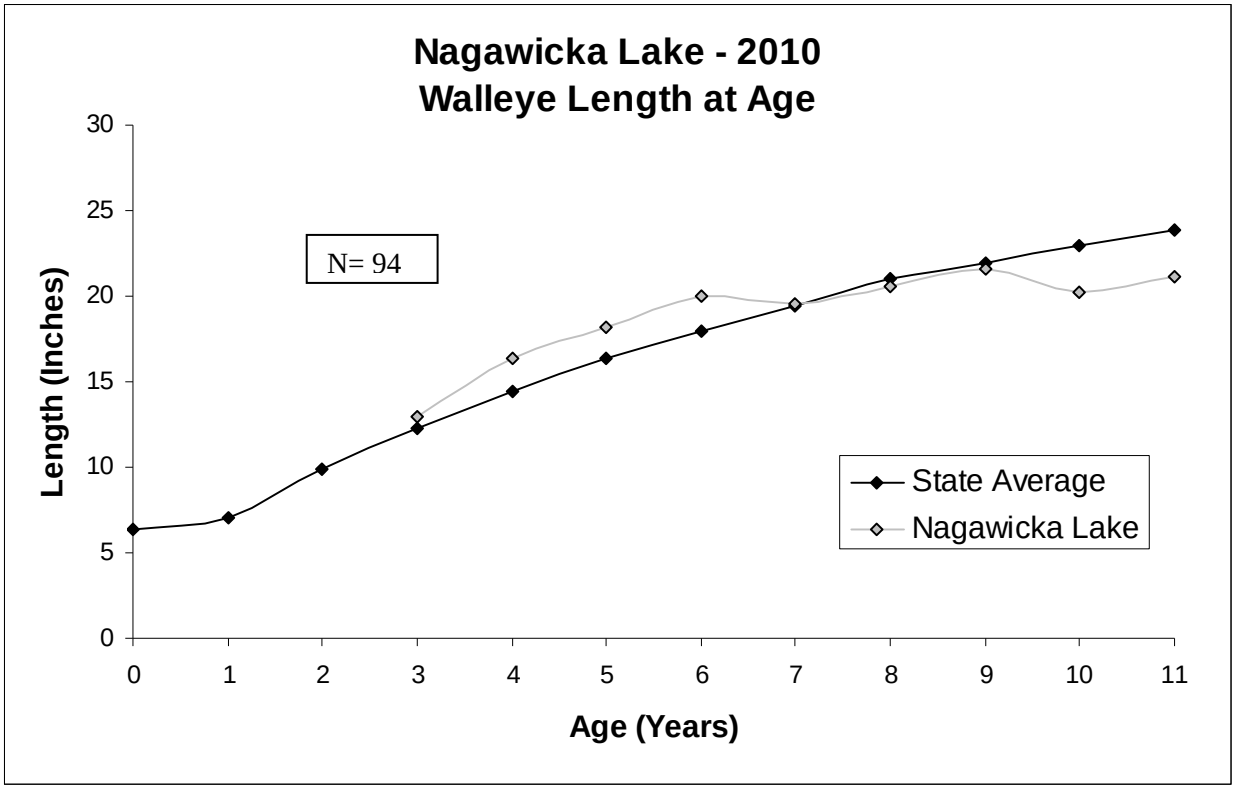

Figure 3. Walleye length at age from Nagawicka Lake compared to the Wisconsin statewide average. Fish were captured by fyke netting and electrofishing during the spring 2010 comprehensive survey.

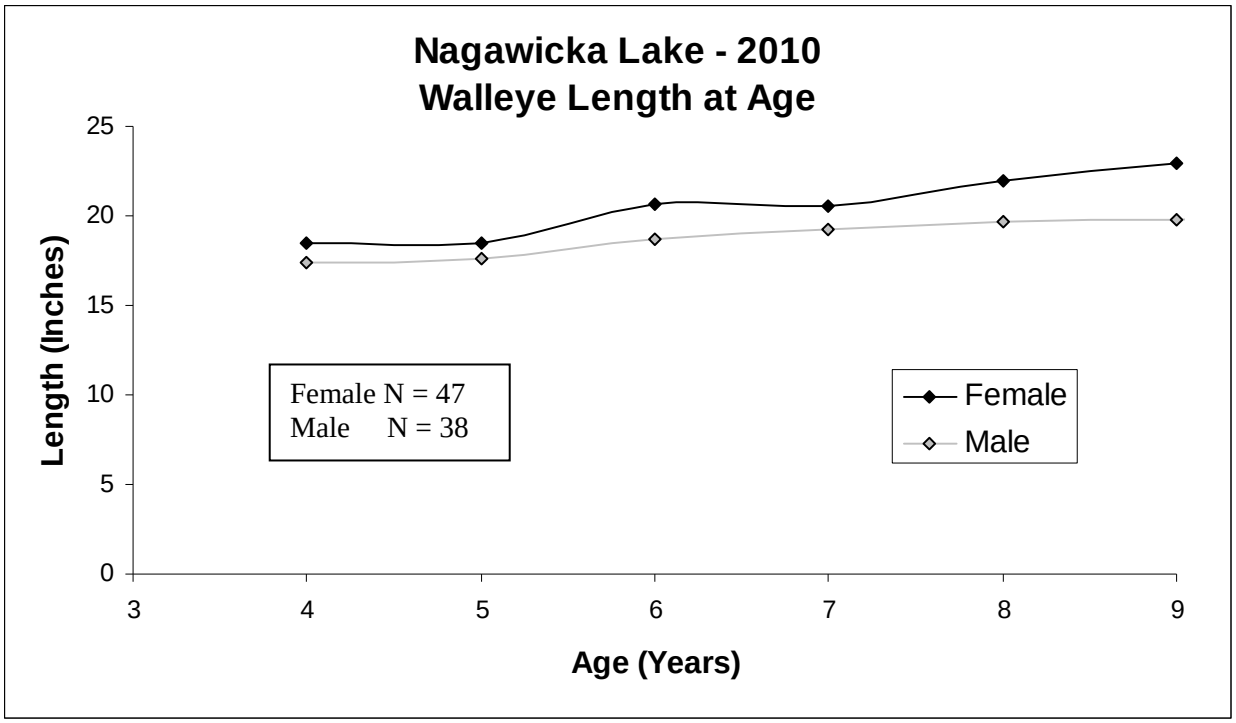

Figure 4. Length at age for male compared to female walleyes in Nagawicka Lake. Fish were captured by fyke netting and electrofishing during the spring 2010 comprehensive survey.

A catch curve was constructed for walleye in Nagawicka Lake, providing an estimate of mortality. Nagawicka Lake walleyes show 46.6% mortality beginning at age 6 or 20.0 inches (Figure 5). Angler harvest contributes significantly to the high mortality rates of walleye with fish older than age six. Age three through five are likely to be under represented in the catch do to lack of vulnerability to gear or simply a lack of recruitment in these year classes.

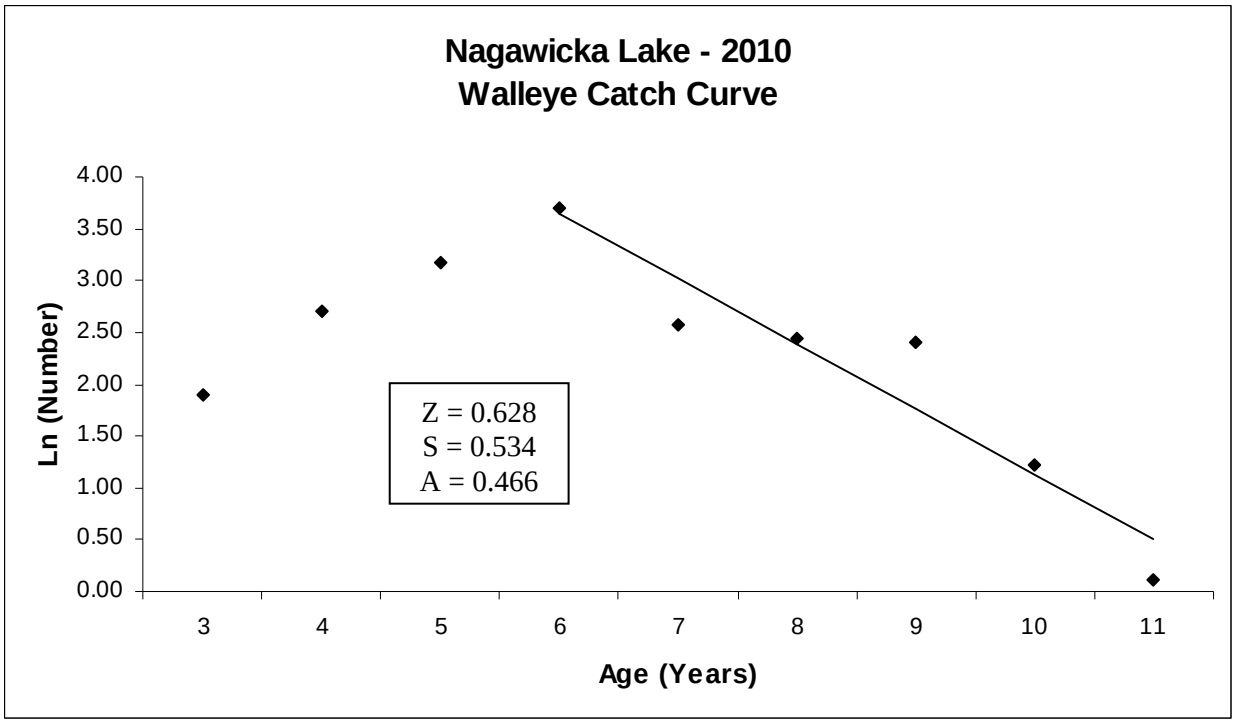

Figure 5. Walleye catch curve for Nagawicka Lake. Fish were captured by fyke netting during the spring 2010 comprehensive survey.

Northern Pike

Northern pike were sampled shortly after ice out on March 22nd and continued until April 15th. Catch rates were good and the average size was modest (Table 4). The largest female sampled was 39.2 inches, whereas the largest male measured 28.5 inches.

Table 4. Northern pike captured by fyke net from Nagawicka Lake in spring of 2010. Total effort of 289 net nights.

Sex	Number Caught	CPE	Mean Length (in)	St. Dev	Mean Weight (lbs)	St. Dev
Male	291	1.007	18.83	3.75	1.618	1.015
Female	240	0.830	22.18	5.43	3.114	2.731
Unknown	23	0.080	13.40	1.96	0.777	0.653
Total	554	1.917	20.06	5.01	2.285	2.189

Both female and male northern pike showed a length frequency mode of 20 inches (Figure 6).

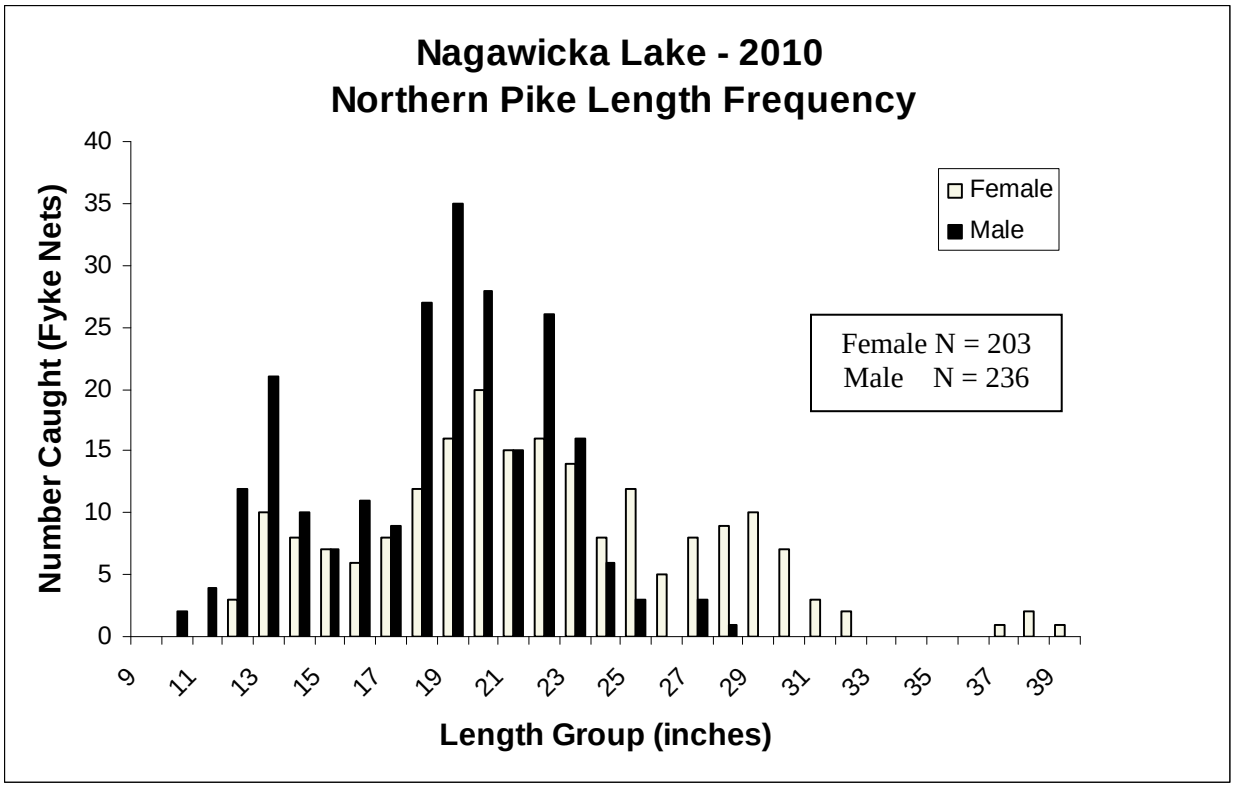

Figure 6. Length frequency for male and female northern pike in Nagawicka Lake. Fish were captured by fyke netting during the spring 2010 comprehensive survey.

Northern pike size structure was average for lakes in southern Wisconsin with a PSD of 51.4%. Gender-specific proportional stock density shows that female northern pike make up a greater proportion of the large fish in the system. Female PSD was 64.6% while male PSD was 38.9%. Female relative stock density (RSD-26), using a stock length of 16 inches and a preferred length of 26 inches (which is the legal length limit for angler harvest), was 27.4% while male RSD-26 was 2.2%.

Northern pike from Nagawicka Lake were given differential finclips throughout fyke netting, allowing for a mark and recapture effort to estimate abundance. The resulting population estimate using the Modified Schnabel method indicated 1,462 adult northern pike in Nagawicka Lake (95% confidence intervals of 1,189 and 1,899), or 1.5 fish/acre (Table 6).

Table 6. Northern pike mark and recapture data from Nagawicka lake. Fish were captured by fyke netting during the spring 2010 comprehensive survey.

Date	Number Caught C(t)	Number Recaptured R(t)	Number Marked (less recaptures)	Marked At Large M(t)
March 23	40	0	40	0
March 24	44	1	43	40
March 25	29	3	26	83
March 27	84	9	75	109
March 29	75	16	59	184
March 31	38	13	25	243
April 2	56	15	41	268
April 3	30	4	26	309
April 5	20	4	16	335
April 7	34	5	29	351
April 9	17	2	15	380
April 10	22	3	19	395
April 11	13	1	12	414
April 12	17	2	15	426
April 13	13	2	11	441
April 14	8	0	8	452
April 15	14	3	11	460

	Population Estimates & 95% C.I.		
Schnabel (Modified)	N	Lower 95%	Upper 95%
R/C = 15%	1,462	1,189	1,899

Scales for ageing were collected from northern pike during fyke netting. Estimates of northern pike growth rates were compared to the statewide average, showing that pike in Nagawicka Lake grow faster than the statewide average rate (Figure 7).

Female and male northern pike growth rates were also calculated separately, allowing for comparison of gender-specific growth rates (Figure 8).

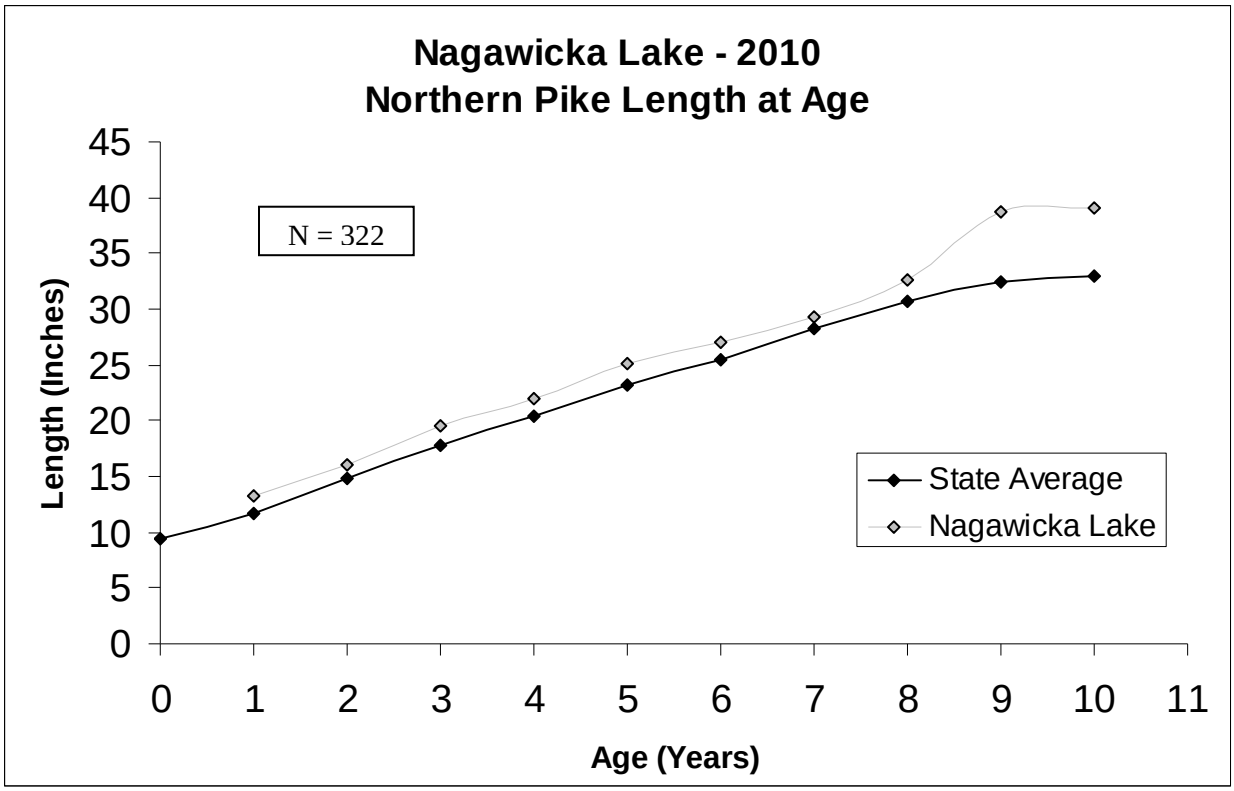

Figure 7. Northern pike length at age for Nagawicka lake compared to the Wisconsin statewide average. Fish were captured by fyke netting during the spring 2010 comprehensive survey.

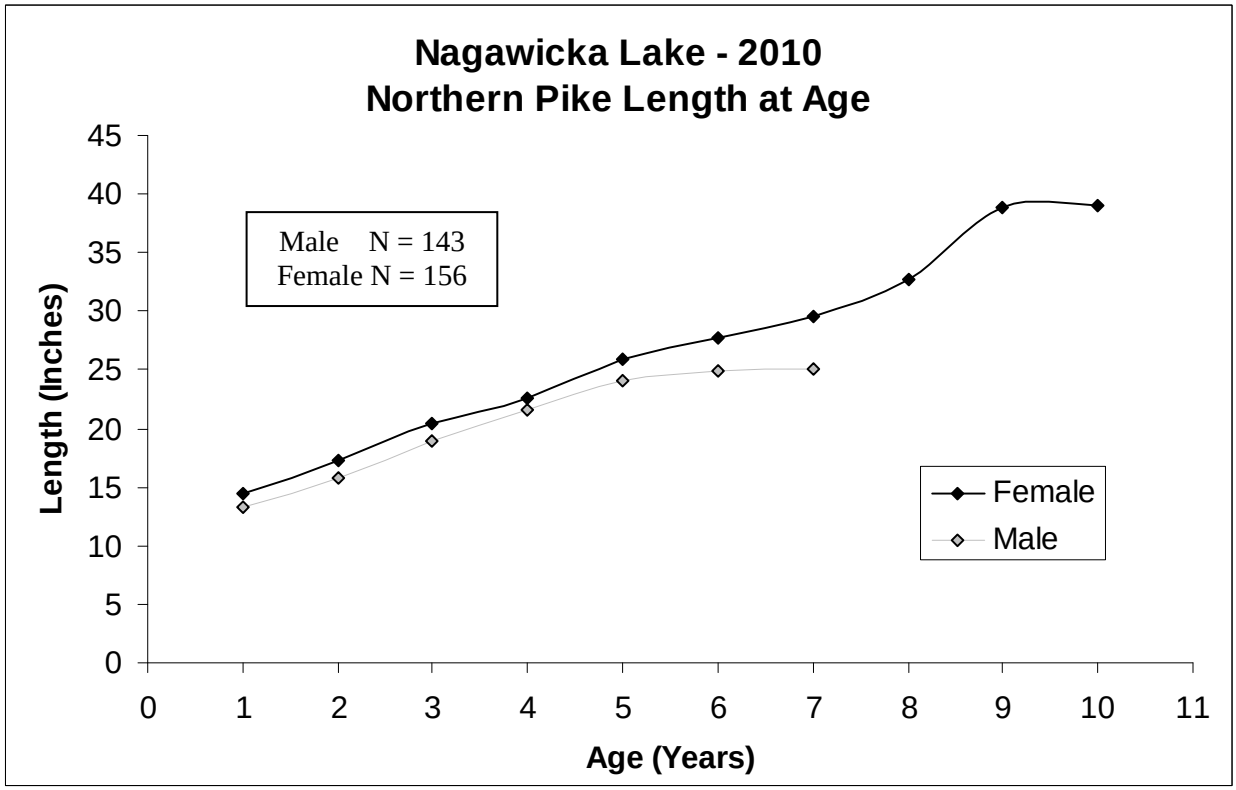

Figure 8. Length at age for male compared to female northern pike in Nagawicka Lake. Fish were captured by fyke netting during the spring 2010 comprehensive survey.

A catch curve was constructed for northern pike in Nagawicka Lake, providing an estimate of mortality. Nagawicka Lake northerns show 48.8% mortality beginning at age 2 or 16.1 inches (Figure 9). Mortality in ages 2-6 are below the 26-inch minimum length limit, meaning mortality is likely due to natural or hooking mortality.

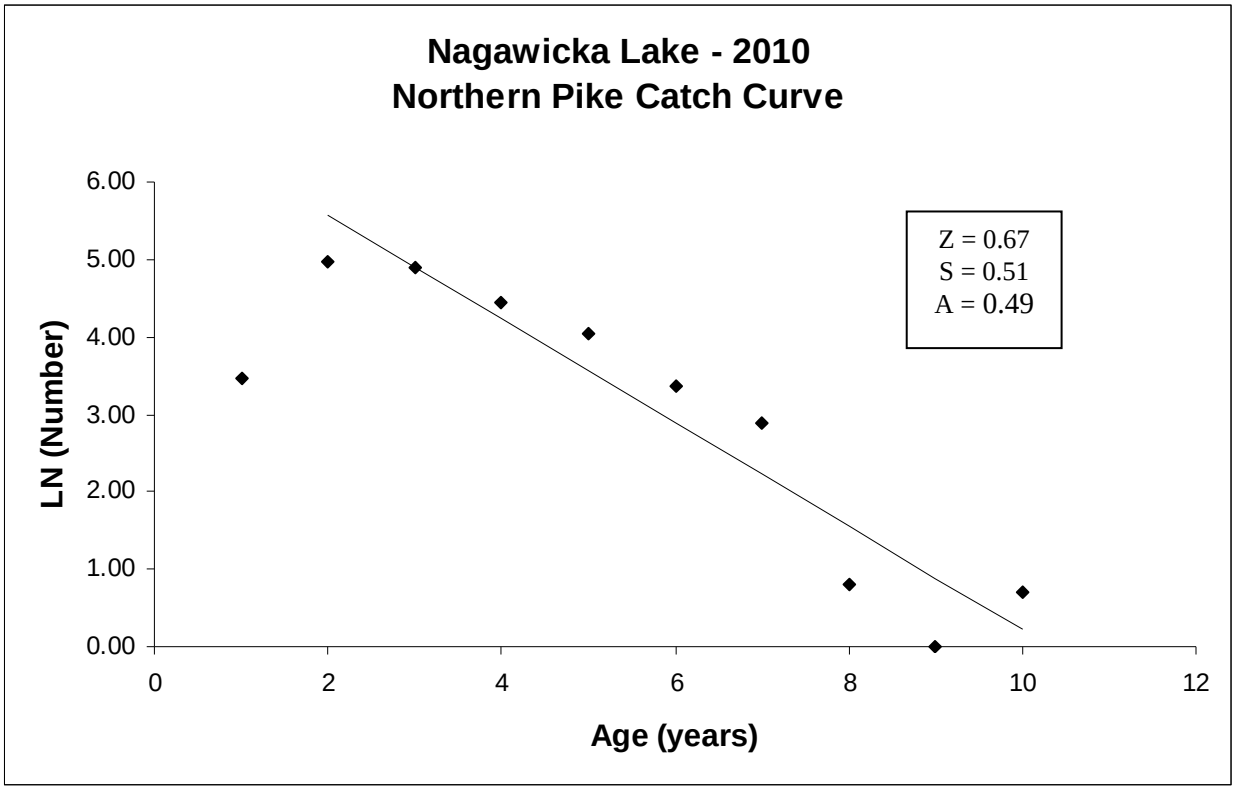

Figure 9. Northern pike catch curve for Nagawicka Lake. Fish were captured by fyke netting during the spring 2010 comprehensive survey.

Smallmouth Bass

Smallmouth bass were captured during fyke netting and electrofishing surveys on Nagawicka Lake in spring of 2010. Smallmouth are not a target species during fyke netting, therefore the 48 bass captured during netting are considered incidental catch and do not contribute to the calculation of growth or mortality rates. General catch statistics from both fyke nets and electrofishing, however, are presented in Table 7. Because smallmouths are not consistently captured in fyke nets, catch rate is low. Electrofishing produced a greater smallmouth bass catch rate of 10.8 caught per hour and an average size of 12.8 inches (Table 7).

Table 7. Smallmouth bass catch statistics for Nagawicka Lake during the spring 2010 comprehensive survey. Netting effort was 289 net nights and electrofishing effort was 25.75 hours.

Gear	Number Caught	CPE	Mean Length (in)	St. Dev	Mean Wt. (lbs)	St. Dev
Boom	277	10.757	12.76	2.84	2.136	0.962
Fyke	48	0.166	14.49	1.93	1.620	0.799
All	325	-	13.02	2.79	1.393	0.867

The length frequency mode for smallmouth bass captured during electrofishing was 10.6 inches, with a

maximum size of 20.0 inches (Figure 10). Overall smallmouth bass PSD (73.2) and RSD-14 (38.7%) indicate a large size structure. Almost 38% of smallmouth bass captured while electrofishing were longer than the 14-inch minimum length for angler harvest.

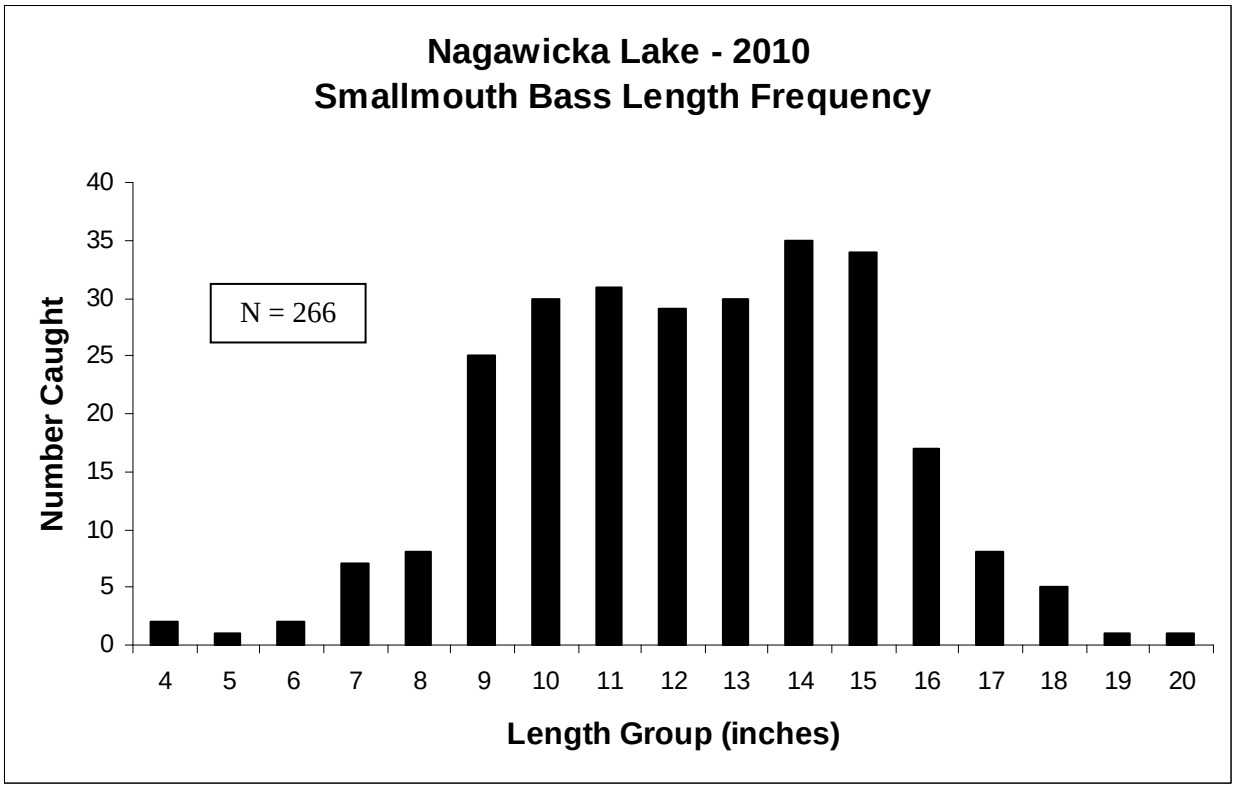

Figure 10. Smallmouth bass length frequency from Nagawicka Lake. Fish were captured by electrofishing during the spring 2010 comprehensive survey.

Smallmouth bass were marked with top caudal finclips throughout fyke netting and electrofishing sampling in an effort to generate a population estimate. Sample size was not large enough to produce a reliable population estimate using the Peterson method.

Scales were collected from smallmouth bass for ageing, allowing for the estimation of growth rates in Nagawicka Lake. Smallmouth in this lake grow slightly faster than statewide average until age 6 where their growth rate decreases to more closely match the statewide average. (Figure 11).

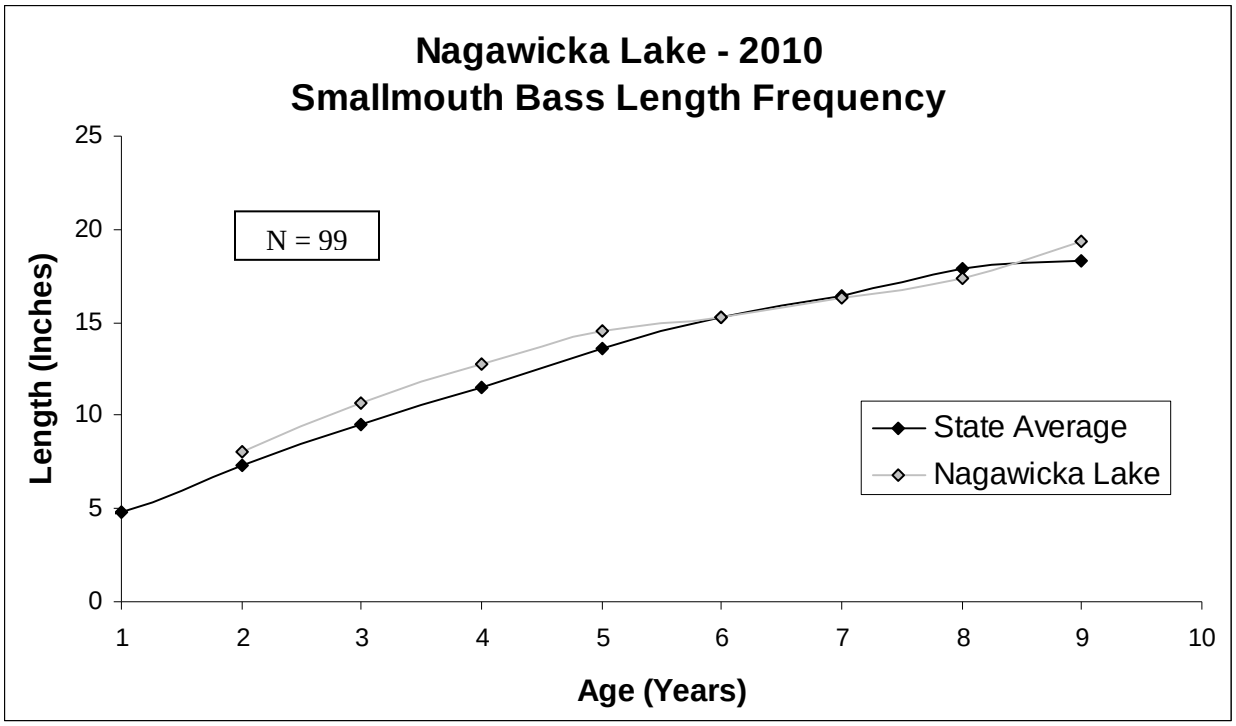

Figure 11. Smallmouth bass length at age for Nagawicka Lake compared to the Wisconsin statewide average. Fish were captured by fyke net and electrofishing during the spring 2010 comprehensive survey.

A catch curve was constructed for smallmouth bass to estimate annual mortality. Smallmouth bass in Nagawicka Lake exhibit 55.6% mortality beginning at age 3, or 10.6 inches (Figure 12). These fish are below the 14-inch minimum length limit for angler harvest, meaning this mortality is likely due to a combination of natural causes and hooking mortality.

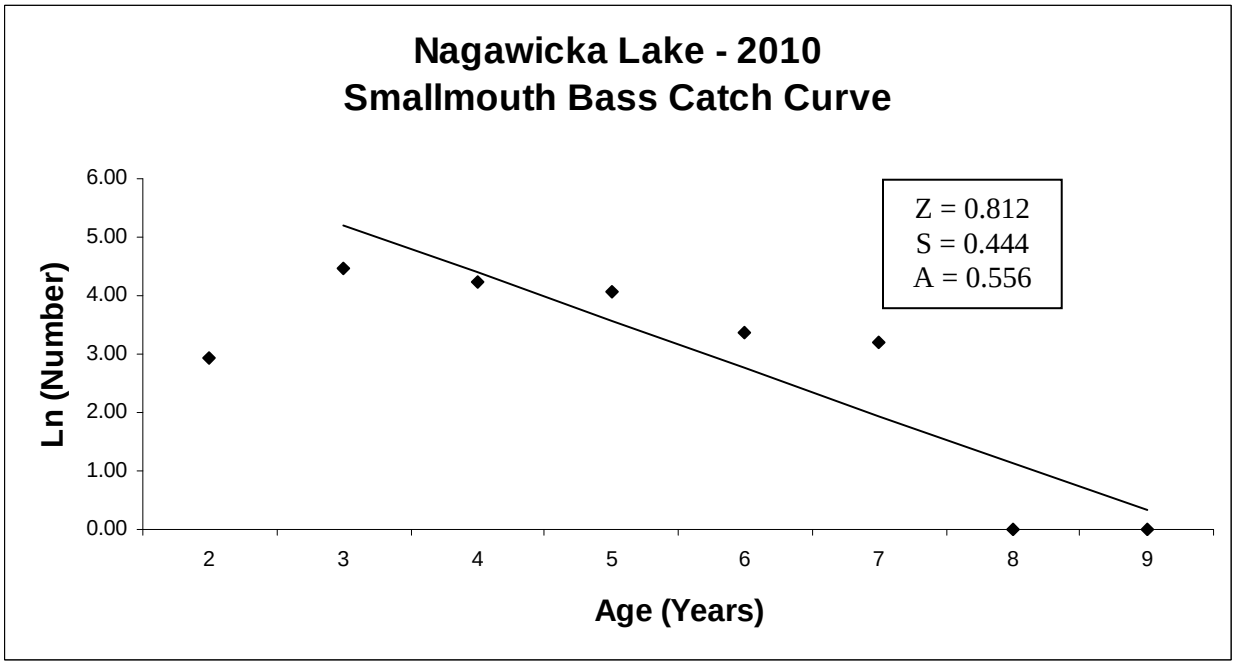

Figure 12. Smallmouth bass catch curve for Nagawicka Lake. Fish were captured by electrofishing during the spring 2010 comprehensive survey.

Largemouth Bass

Largemouth bass were sampled from Nagawicka Lake throughout the entire spring 2010 sampling survey. The 142 largemouth bass captured during fyke netting were regarded as incidental catch, as bass are not targeted during fyke netting surveys. General catch statistics from both fyke nets and electrofishing are presented in table 8. Because largemouth bass are not consistently captured in fyke nets, electrofishing is a better measure of relative abundance. Largemouth bass captured in fyke nets had a longer mean length than largemouth caught by electrofishing. It should be noted, though, that fyke nets tend to be biased toward the larger, mature adults. Largemouth captured during electrofishing had an average size of 13.5 with the largest largemouth bass measuring 20.8 inches. A sub sample of bass were measured for weight while fyke netting and electrofishing during the survey (Table 8).

Table 8. Largemouth bass catch statistics for Nagawicka Lake during the spring 2010 comprehensive survey. Netting effort was 289 net nights and electrofishing effort was 25.75 hours.

Gear	Number Caught	CPE	Mean Length (in)	St. Dev	Mean Wt. (lbs)	St. Dev
Boom	613	23.81	13.48	1.86	1.870	1.108
Fyke	142	0.49	14.49	2.04	1.660	0.957
All	755	-	13.68	1.94	1.749	1.024

The length frequency mode for largemouth captured by electrofishing was 14.2 inches (Figure 13). Overall largemouth PSD, at 82.07%, and RSD-15, at 19.2%, indicate a relatively large size structure. Anderson (1980) recommends a largemouth bass PSD from 40-70%, with an RSD-15 between 10-25%. Just over 40% of largemouth bass sampled during electrofishing were longer than the 14-inch minimum length for angler harvest.

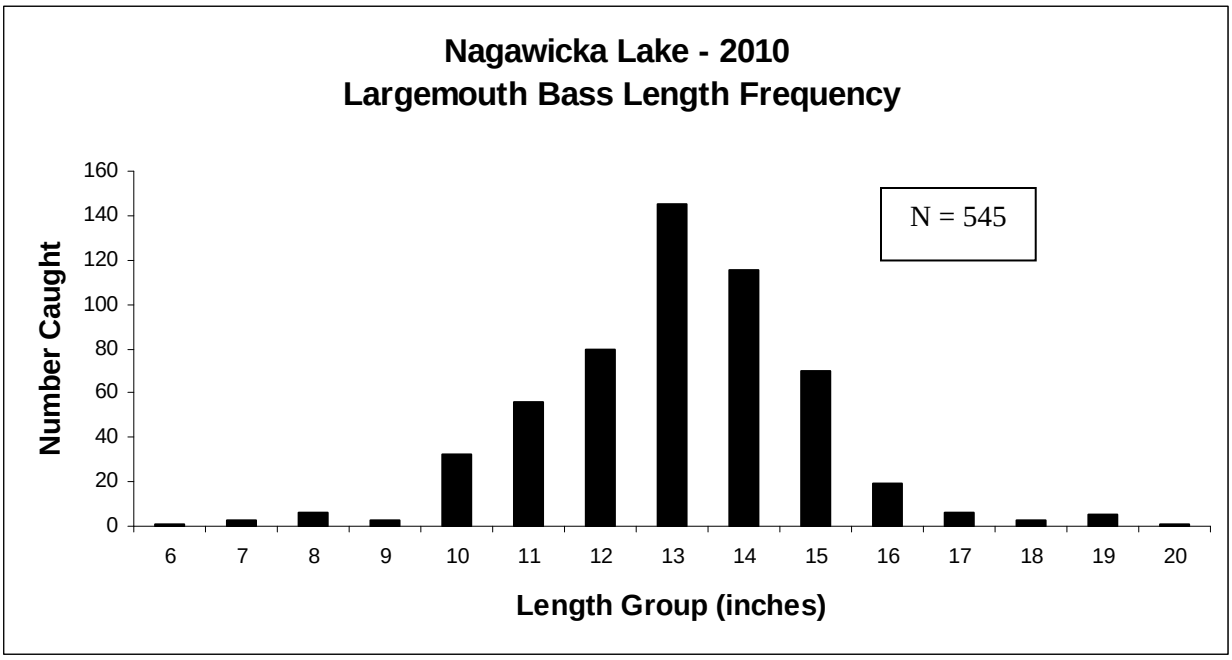

Figure 13. Largemouth bass length frequency for Nagawicka Lake. Fish were captured by electrofishing during the spring 2010 comprehensive survey.

Largemouth bass were marked with top caudal finclips throughout fyke netting and electrofishing sampling in an effort to generate a population estimate. Using the Peterson method, it is estimated that there are 2,773 largemouth bass in Nagawicka Lake which is equal to 2.8 fish/acre (95% C.I. of 1,693 and 5,297, CV of 26.7%) (Table 9).

Table 9. Largemouth bass mark and recapture data and Petersen population estimate from Nagawicka Lake in spring of 2010 (R/C=0.22, CV=26.7%).

Marked	Examined	Recaptured	Population Estimate	Lower 95%	Upper 95%
M	C	R	N	C.I.	C.I.
598	51	11	2,773	1,693	5,297

Scales were collected from largemouth bass for ageing, allowing for the estimation of growth rates in Nagawicka Lake. Largemouth in Nagawicka Lake grow at a rate that mimics the Wisconsin statewide average (Figure 14).

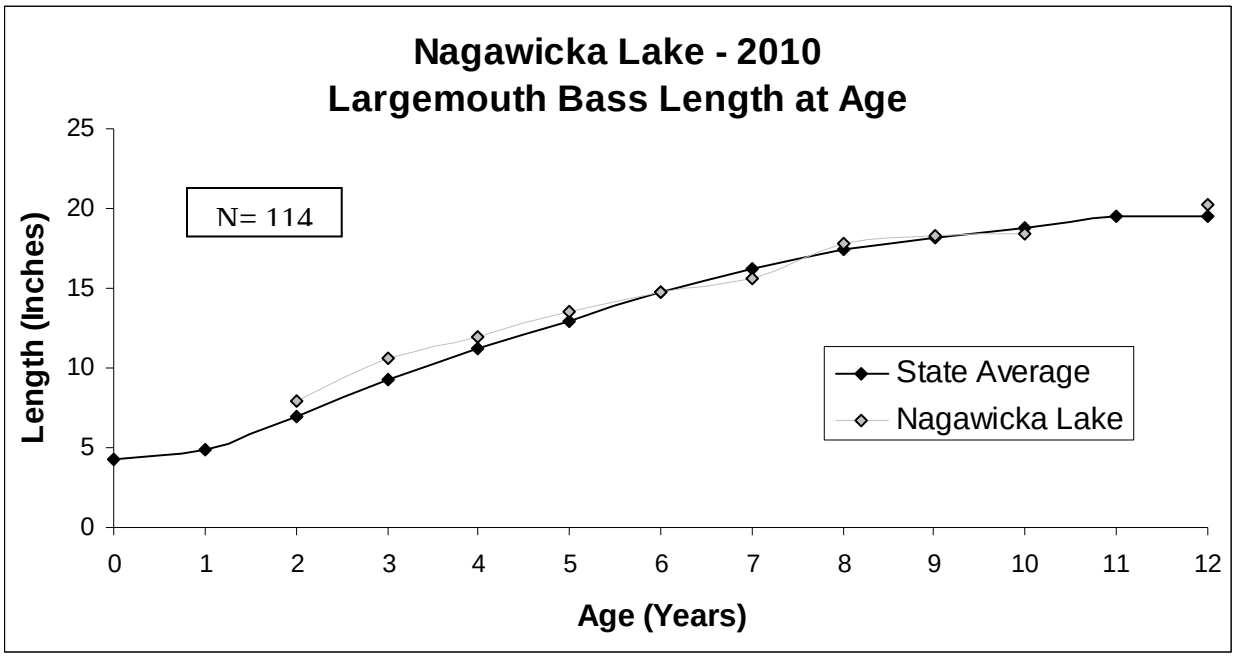

Figure 14. Largemouth bass length at age for Nagawicka Lake compared to the Wisconsin statewide average. Fish were captured by fyke net and electrofishing during the spring 2010 comprehensive survey.

A catch curve was constructed for largemouth bass to estimate annual mortality. Largemouth bass in Nagawicka Lake exhibit 55.0% mortality beginning at age 5, or 13.5 inches (Figure 15). These fish are near the 14-inch minimum length limit for angler harvest, meaning this mortality is likely due to a combination of natural causes, hooking mortality and angler harvest.

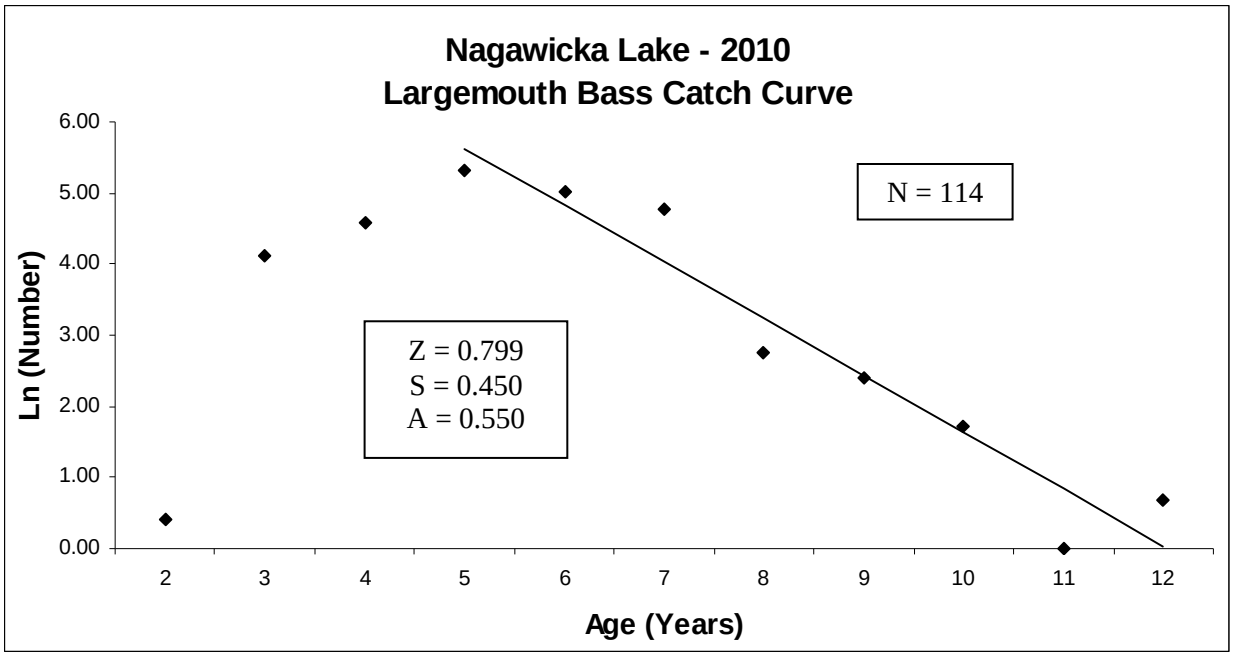

Figure 15. Largemouth bass catch curve for Nagawicka Lake. Fish were captured by fyke net and electrofishing during the spring 2010 comprehensive survey.

Panfish

Many panfish were captured during the spring 2010 comprehensive survey including black crappie, bluegill, pumpkinseed, rock bass, and yellow perch. Bluegill and rock bass were the most prevalent of this group with almost 5,000 and 2,500 individuals captured of each species, respectively. General panfish catch statistics are presented in table 10.

Table 10. Panfish Catch Statistics for Nagawicka Lake during the spring 2010 comprehensive survey. Netting effort was 289 net nights and electrofishing effort was 23.25 hours.

Species/Gear	Number Caught	CPE	Mean Length (in)	St. Dev	Max Length (in)
Black Crappie/Fyke	186	0.644	10.16	2.45	14.00
Black Crappie/Boom	1	0.043	13.80	-	13.80
Black Crappie/All	**187**	**-**	**10.77**	**2.65**	**14.00**
Bluegill/Fyke	4975	17.215	5.92	1.09	8.80
Bluegill/Boom	15	0.645	5.19	0.77	6.80
Bluegill/All	**4990**	**-**	**5.88**	**1.09**	**8.80**
Pumpkinseed/Fyke	6	0.021	4.30	-	4.30
Pumpkinseed/Boom	0	-	-	-	-
Pumpkinseed/All	**6**	**-**	**4.30**	**-**	**4.30**
Rock Bass/Fyke	2479	8.578	6.02	1.97	11.50
Rock Bass/Boom	50	2.151	7.62	1.95	11.60
Rock Bass/All	**2529**	**-**	**6.49**	**2.09**	**11.60**
Yellow Perch/Fyke	746	2.581	5.21	0.96	7.30
Yellow Perch/Boom	53	2.280	5.45	1.25	8.60
Yellow Perch/All	**799**	**-**	**5.38**	**1.16**	**8.60**

Nagawicka Lake shows length frequency modes of 6.1 inches for bluegill (Figure 16), 7.2 inches for rock bass (Figure 17), and 4.1 inches for yellow perch (Figure 18).

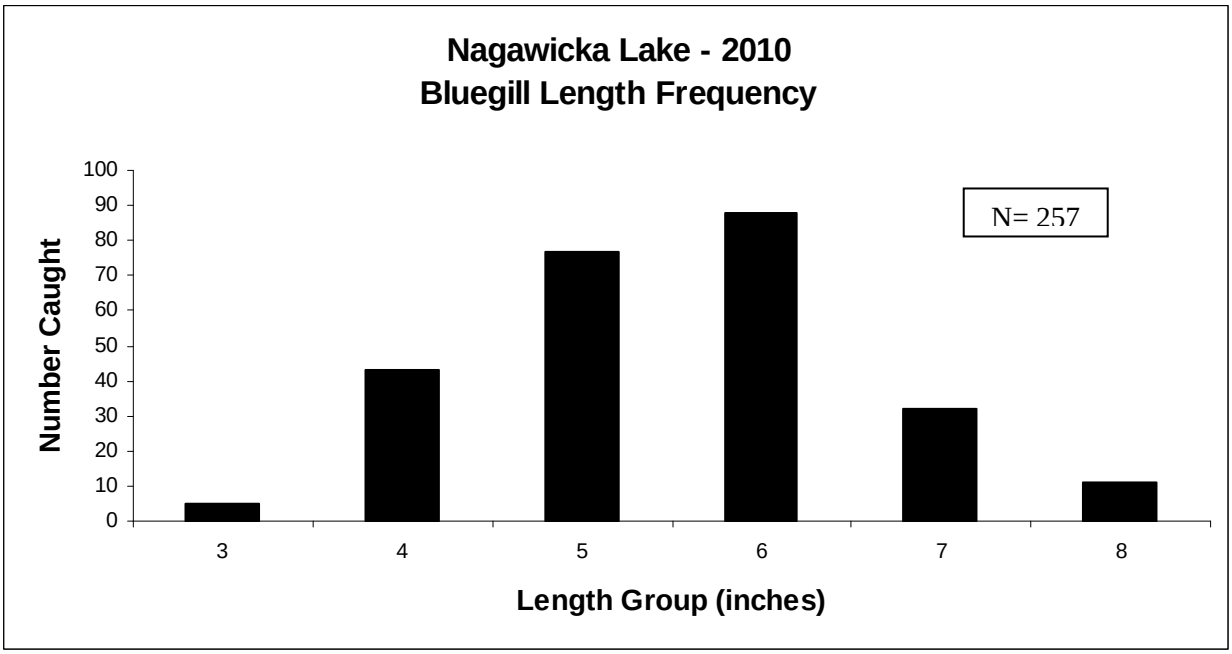

Figure 16. Bluegill length frequency for Nagawicka Lake. Fish were captured by fyke net and electrofishing during the spring 2010 comprehensive survey.

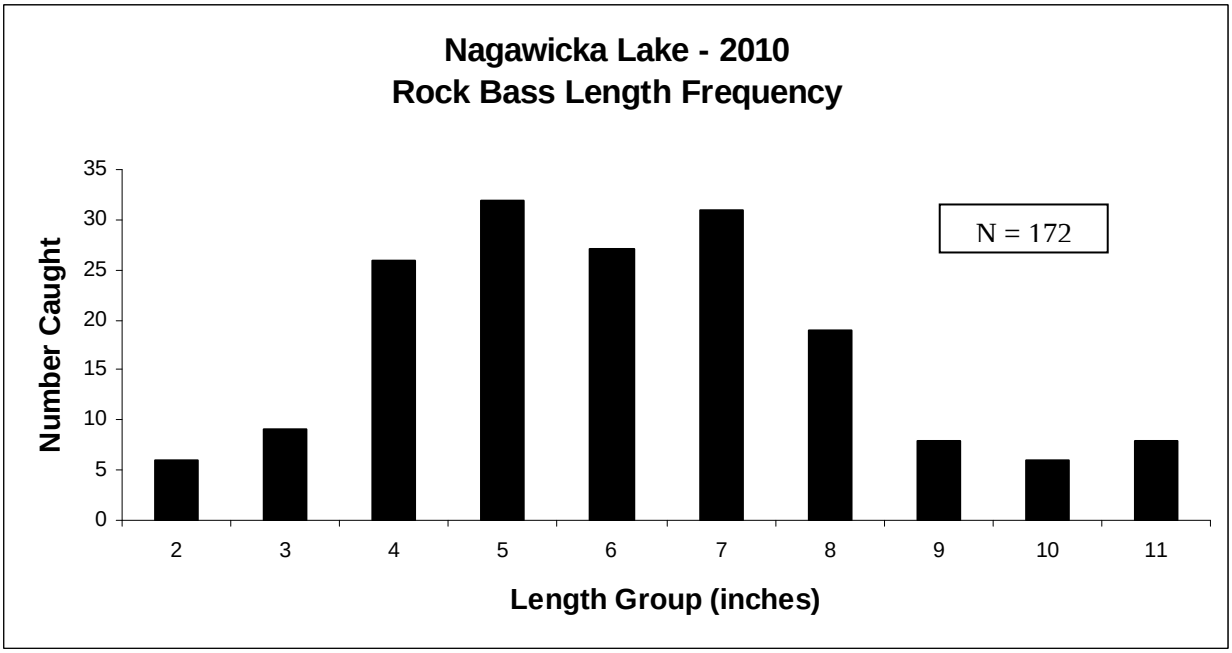

Figure 17. Rock bass length frequency for Nagawicka Lake. Fish were captured by fyke net and electrofishing during the spring 2010 comprehensive survey.

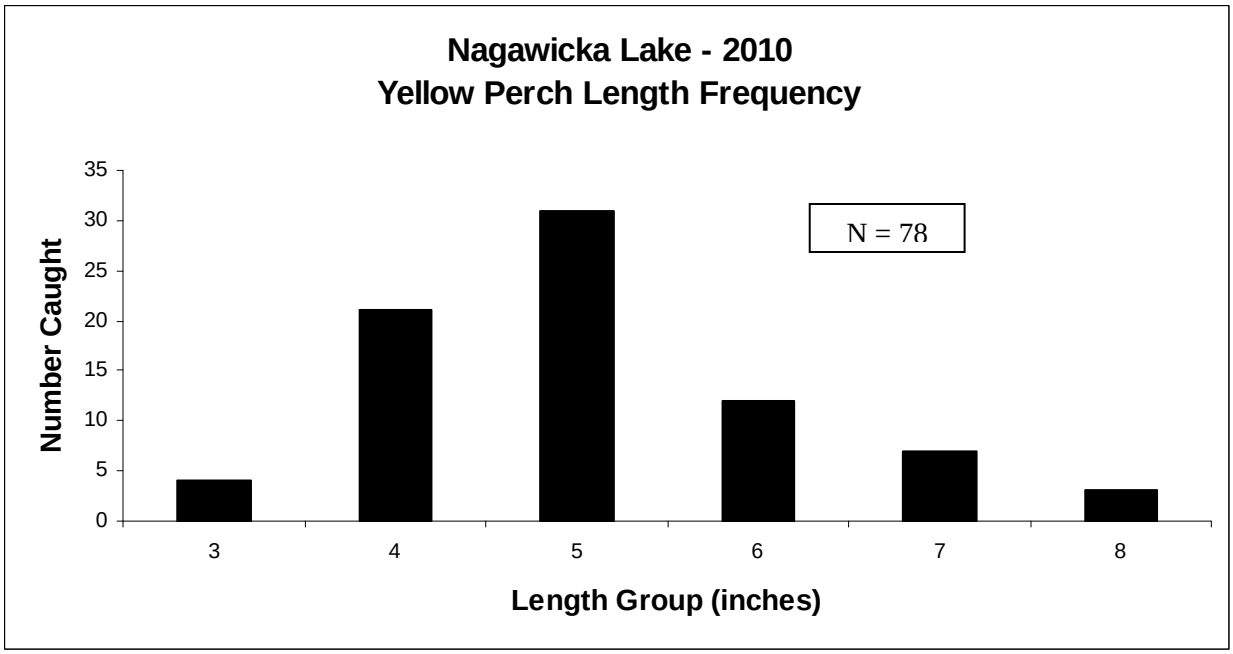

Figure 18. Yellow Perch length frequency for Nagawicka Lake. Fish were captured by fyke net and electrofishing during the spring 2010 comprehensive survey.

Using a stock size of 3 inches, a quality size of 6 inches, and a preferred size of 8 inches, Nagawicka bluegills have a PSD of 51.2% and a RSD-8 of 4.3% indicating a balanced size structure. Using a stock size of 4 inches, a quality size of 7 inches, and a preferred size of 9 inches, Nagawicka rock bass have a PSD of 45.9% and a RSD-9 of 14.01% indicating a large size structure.

Other Species

Several other "non-gamefish" species were captured during the spring 2010 survey on Nagawicka Lake. Seven other species were sampled during fyke netting, with white sucker, bowfin, and yellow bullhead being the most prevalent (Table 11).

Table 11. 'Other Species' catch statistics for Nagawicka Lake during the spring 2010 comprehensive survey. Effort = 289 net nights for all species except golden shiner (2.25 hours of electrofishing).

Species	Number Captured	CPE
Bowfin	69	0.239
Brown Bullhead	1	0.003
Common Carp	2	0.007
Golden Shiner	1	0.444
Lake Chubsucker	7	0.024
White Sucker	87	0.301
Yellow Bullhead	53	0.183
Yellow Bass	1	0.003

DISCUSSION

Walleye catch rates on Nagawicka Lake were low during fyke netting as roughly one fish was captured per three net nights. Higher catch rates were observed during electrofishing with almost 3 fish captured

per hour of shocking. Previous surveys show low walleye catch rates as well, however, the most recent survey targeted northern pike and nets were pulled prior to peak walleye capture. Many adult walleye were most likely missed by our gear during the 2010 survey because they are known to swim out of the lake and up the Bark River which flows unobstructed for approximately 7.5 miles from the nearest dam to the inlet to Nagawicka Lake. Future surveys should include a stream electrofishing survey in the Bark River between its outflow into the lake and the nearest dam upriver. Average lengths of fish were longer while fyke netting (19.8 inches) compared to electrofishing (16.2 inches) which is to be expected because the larger, sexually mature fish are more susceptible to fyke net capture.

Total adult walleye abundance was estimated at 388 individuals or, 0.4 adults/acre which is low but not uncommon for lakes in Southeastern Wisconsin. Walleye growth rates in Nagawicka Lake were higher than the Wisconsin state average, with females growing faster than males. A fall 2010 walleye stocking assessment survey was conducted during two evenings in early October and early November. During the survey, 26 walleyes were captured via electrofishing. Of these, 10 fish, or 63%, were between 8-9 inches which is the length the young of the year fish were assumed to be. With a catch rate of 0.91 fingerlings/mile, the fall 2010 survey was below average when compared to other stocking assessments between the years 1981-1998. The 10 fingerlings captured during the fall 2010 survey were kept and sent in for OTC marking analysis which will help determine what percentage of the fingerlings in the lake were stocked compared to naturally reproduced. Walleye stocking could be enhanced by the stocking of extended growth walleye fall fingerlings as well as habitat protection and restoration. Accelerated walleye growth rates and variable stocking success exhibit the need to protect female walleyes in Nagawicka Lake for at least two spawning seasons in hopes of creating a greater proportion of naturally reproduced walleye.

Northern pike catch rate during fyke netting was slightly higher than the previous survey which was conducted in 2002. Average lengths for northerns have increased since 2002 by almost 6 inches. Average weight also increased. Although some nice northern pike were seen in the 2010 survey, size structure for northern pike is relatively small as indicated by a PSD of 51.4% and RSD-28 of 10.1%. Only 11.3% of fish captured were above the 26-inch minimum size limit for angler harvest. This is, however, a great improvement over the previous survey where only 1 fish out of 113 captured was over the 29-inch minimum size limit. Nagawicka Lake northern pike grow at a rate slightly faster than the Wisconsin statewide average, while females grow faster than males. Northern pike are commonly targeted by ice anglers on Nagawicka lake, with a high frequency of success. Since 2008, northern pike have been stocked into Nagawicka Lake in the fall as large fingerlings.

Smallmouth bass catch rate on Nagawicka Lake was good while electrofishing and size structure was well balanced. Almost 40% of smallmouth captured during electrofishing were longer than the 14-inch minimum, with an average size close to 13 inches. These figures show an increase in size structure from a Spring 2000 winterkill survey where only 10% of the smallmouth captured were at or above the 14-inch minimum and the average length was just over 10 inches. Although catch rate while electrofishing during the spring 2010 survey was good, not enough fish were captured to produce a reliable population estimate. Smallmouth growth rates on Nagawicka were similar to the state average, and age 3+ smallmouth (10.6 inches and up) showed a 55.6% mortality rate.

Largemouth bass were more frequently observed than smallmouth, and size structure was above average. Over 40% of largemouth captured while electrofishing during the survey were larger than the 14-inch minimum length limit with the average fish being 13.5 inches. Similar to smallmouth, these numbers are higher than what was seen during a spring 2000 winterkill survey where 20% of largemouth were at or above the 14-inch minimum and the average length was just over 11 inches. A population estimate of

2,773 adult largemouth bass signifies a population density of 2.8 adult fish/acre. Largemouth growth rates on Nagawicka were similar to the state average, and age 5+ largemouth (13.5 inches and up) showed a 55.0% mortality rate.

Panfish on Nagawicka Lake were quite common during fyke netting and electrofishing. This survey indicates particularly nice bluegill and rock bass populations with PSD values of close to 50% each. Other "non-game" species were captured by fyke netting during the survey. Of the eight additional species captured, one of the most common was white sucker. This species is an important forage source for game species such as northern pike and walleye. Nagawicka Lake and the adjoining Bark River, are historically known for its white sucker spawning run.

Future management recommendations include:

- Transition to a more restrictive length and bag limit for walleye to continue protection of female walleyes for multiple spawning seasons and potentially increase the contribution of natural recruitment to the walleye population.
- Convert from stocking small fingerling to large fingerling walleyes to increase survival and overall adult abundance.
- Monitor walleye population for contribution of stocked versus naturally reproduced fish to each year class through OTC marking.
- Continue regular stocking of large fingerling northern pike to increase survival and improve overall abundance.
- With high mortality rates above the 26-inch minimum size limit, restrict angler harvest to one northern pike per day with a 32-inch minimum length limit.
- Continue to monitor bass and panfish populations using catch rates, average sizes, and abundance estimates.
- Monitor white sucker population and spawning success because of their importance as a gamefish forage species.
- Protect and improve habitat and water quality to promote diverse and healthy fish communities.

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